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| 10/765,732      | 01/27/2004  | Blaine D. Johs       |                     | 2478             |

7590 06/01/2006  
JAMES D. WELCH  
10328 PINEHURST AVE.  
OMAHA, NE 68124

EXAMINER

DETSCHEL, MARISSA

| ART UNIT | PAPER NUMBER |
|----------|--------------|
|----------|--------------|

2877

DATE MAILED: 06/01/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/765,732

Applicant(s)

JOHS ET AL.

Examiner

Marissa J. Detschel

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 27 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-18 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 14-18 is/are allowed.
- 6) ☒ Claim(s) 1-9, 12, 13 is/are rejected.
- 7) ☒ Claim(s) 10 and 11 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 1/27/04.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Information Disclosure Statement***

The information disclosure statement filed on January 27, 2004, has been fully considered by the Examiner except for document AC, listed as Document number 5,484,701. Norton is not the named inventor of 5,484,701. The Examiner believes this should be 5,486,701, which has Norton as a named inventor, and this document number has been included on the PTO-892 form enclosed with this Office Action.

### ***Drawings***

The drawings are objected to because Figures 1, 2, 9, and 10 fail to distinguish amongst the various lines of data on the graphs. All the lines appear as a single solid line, failing to distinguish amongst them.

Furthermore, figures 5-8 are informal, presenting stray marks and lines in the background of the figures, causing them to appear messy.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering

of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### ***Specification***

The disclosure is objected to because of the following informalities: A series of grammatical errors and misspelled words are scattered throughout the disclosure.

Examples of these are:

- On page 1, lines 29-32, the statement "However, control of the properties of the dielectric material formed during a fabrication poccedure are sensitive to changes in the procedure, which changes are often difficult t detect and control." Should read "However, control of the properties of the dielectric material formed during a fabrication procedure is sensitive to changes in the procedure, which changes are often difficult to detect and control."
- On page 3, line 20, the phrase "Patents which discuss monitoring wittness samples are:" should read "Patents which discuss monitoring witness samples are:"
- On page 4, line 26, the word "ellipsometric" should read "ellipsometric"
- On page 8, line 24, the word "benefical" should read "beneficial"
- On page 11, lines 19-23 and page 17, lines 2-4, the statement "Fig. 10 shows resluts similar to those in Fig. 9, but for the case where 10 Angstroms of

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Amorphous Carbon (a-carbon) are substituted for the Amporphous Silicon (a-Si)." Should read "Fig. 10 shows results similar to those in Fig. 9, but for the case where 10 Anstroms of Amorphous Carbon (a-carbon) are substituted for the Amorphous Silicon (a-Si)."

- On page 13, line 11 and page 15, line 4, the word "parameters" should read "parameters"
- On page 13, line 21 and page 15, line 22, the word "wittness" should read as "witness"
- On page 13, line 25, the word "appearant" should be "apparent"
- On page 16, line 12, the word "oscilations" should be "oscillations"
- On page 16, line 19, the word "approach" should be "approach"

Appropriate correction is required.

### ***Claim Objections***

The numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. When claims are canceled, the remaining claims must not be renumbered. When new claims are presented, they must be numbered consecutively beginning with the number next following the highest numbered claims previously presented (whether entered or not).

Two claims numbered 11 appear in the listing of claims.

Misnumbered second claims 11-17 have been renumbered claims 12-18.

In view of this change, the dependencies of renumbered claims 15-18 should be changed as follows:

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- Claim 15-18 should read "A method for evaluating thickness of an ultrathin film as in claim 14"

Furthermore, Claims 1, 7, 8, 11, 12, 14, and 15 are objected to because of the following informalities:

- Regarding claim 1, lines 1-3, the phrase "a sample comprised of a sequence of at least one layer of material, each said layer having a thicknesses" should read "a sample comprised of at least one layer of material, each said layer having a thickness" At least one layer of material cannot include a sequence, since one layer of material does not represent a sequence.
- Regarding claim 7, line 2, the phrase "different fabricated structure" should read "different fabricated structures"
- As to claim 8, a semicolon should be inserted and the end of part c, allowing part c to read "c) fabricating a second sample which is meant to be the same as the reference sample;"
- As to claim 8, part d, line 2, the phrase "detecting differences said" should read "detecting differences in said"
- As to claim 11, the listing of the variables for  $N_1$ ,  $C_1$ ,  $S_1$ ,  $N_2$ ,  $C_2$ , and  $S_2$  in correspondence with

$$\begin{aligned} N_1 &= \cos(2\Psi); \\ C_1 &= \sin(2\Psi)\cos(\Delta); \\ S_1 &= \sin(2\Psi)\sin(\Delta); \end{aligned}$$

and

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$$\begin{aligned} N_2 &= \cos(2\Psi); \\ C_2 &= \sin(2\Psi)\cos(\Delta); \\ S_2 &= \sin(2\Psi)\sin(\Delta); \end{aligned}$$

should read  $N_o$ ,  $C_o$ ,  $S_o$ ,  $N_f$ ,  $C_f$ , and  $S_f$  to correspond with the equation

$$\sqrt{\frac{(N_f - N_o)^2 + (C_f - C_o)^2 + (S_f - S_o)^2}{3}}$$

given in claim 11.

- As to claim 12, line 2, the phrase "which has a sequence" should read "having a sequence"
- As to claim 14, part b, line 3, the phrase "and via a detector" should read "and, via a detector,"
- As to claim 14, part b, line 4, the phrase "spectroscopic ellipsometric" should read "spectroscopic ellipsometric"
- As to claim 14, part c, line 5, the phrase "and via a detector" should read "and, via a detector,"
- As to claim 14, part c, line 6, the phrase "spectroscopic ellipsometric" should read "spectroscopic ellipsometric"
- As to claim 18, line 2, the phrase "optcal constants" should read "optical constants"

Appropriate correction is required.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3 and 5-7 are rejected under 35 U.S.C. 102(b) as being anticipated by Solomon et al. (USPN 5,900,633).

With regard to claim 1, Solomon discloses a method of investigating a sample comprised of a sequence of layers of material comprising the steps of

a) providing two samples, at least one of which comprises at least one thin layer of material thereon;

Solomon's method comprises providing a first sample of at least first and second regions with each region being comprised of at least one layer of material having parameters that are designated by the layer's dielectric function, its thickness, or both. Solomon's method also comprises providing a reference spectrum having features that are indicative of the values of the parameters relating to the layers of the first sample. (column 3, lines 36-50) The reference spectra may be obtained from a set of prefabricated wafers, the fabricated wafers representing the second sample (column 11, lines 60-63).



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b) obtaining spectroscopic data for each of the samples by causing polychromatic electromagnetic radiation to interact with each said sample and then enter a detector to the end that spectra for both samples are provided;

Solomon provides a method for causing polychromatic radiation to impinge on a sample (20) and emanate off the sample after interaction with the sample to be measured by a spectrometer (22). (column 5, lines 42-47 and column 6, lines 41-49 and 54-57)

c) subtracting the obtained spectra from one another;

d) determining differences in said spectra; and

e) analyzing said differences in the spectra.

The spectra from the measured and reference samples are subtracted from each other in the method of Solomon, yielding a difference spectrum. (column 4, lines 47-50) This difference spectrum is used to evaluate the parameters of the layers of the sample being analyzed (column 3, lines 50-54)

In regards to claim 2, the layers in the method of Solomon are represented by a series of layers characterized by a matrix which depends on each of the layers' thicknesses and dielectric functions (column 8, lines 24-29). Each of the layers in

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Solomon's method has its own distinct dielectric function, and, therefore, represents a sequence of high and low "K" dielectric constant layers of material.

Regarding claim 3, one of the samples of Solomon's method can be without an intentional sequence of high and low "K" dielectric constant layers thereupon and the other can be with an intentional sequence. This is illustrated in that the reference spectra need to illustrate the "at least one layer" of one or the other regions of the sample. (column 3, lines 57-66) Therefore, the reference spectra is represented by a reference sample comprising just one of the high and low "K" dielectric constant layers of the test sample, and not for the entirety of the sequence of the layers.

In regard to claim 5, both samples of Solomon's method have a sequence of high and low "K" layers present upon them. The reference spectrum used has parameters that are indicative of the values for the foregoing parameters of the measured spectrum of the layers. Therefore, both samples would have a sequence of the same types of layers on them so these parameters of the reference sample are accurate.

Regarding claims 6 and 7, Solomon's method can be used to measure samples with similar and different fabricated structures, and the difference in the spectroscopic spectra can be used to indicate a desirable or undesirable fabrication process.

Solomon's method comprises a management step that constitutes a simple pass/fail operation where the article produced is either accepted or rejected based on whether or not the article falls in predetermined criteria (column 4, lines 38-43). The predetermined criteria are based on the reference spectra of the reference sample provided. This illustrates a method where the samples have similar fabricated structures and the

difference in the spectra illustrates an undesirable fabrication process (i.e. fail of the pass/fail).

One of the embodiments of Solomon allows a user to analyze a sample before and after fabrication processes to provide a first measurement to be compared to a measurement of a second sample in the form of a reference sample. In this case, the first measurement is in the form of a differential relationship between the before and after fabrication process. This measurement indicates the parameters of the at least one film formed during the fabrication process. The differences in the reference sample spectrum and the measurement spectrum of the first sample are used to manage the manufacturing of the article. (column 5, lines 1-12) Therefore, since the first measurement is taken after a fabrication process of a first sample and the reference spectrum is from a set reference sample, this indicates a different fabricated structure for both samples since one goes through a fabrication process and the other does not. The adjustment in the management of the manufacturing during the fabrication process indicates a desired difference.

Claims 8, 9, 12, and 13 are rejected under 35 U.S.C. 102(a) as being anticipated by Kiyota (USPN 6,605,512).

In regards to claim 8, Kiyota discloses a method of tracking fabrication of a sample comprising a sequence of high and low "K" dielectric constant layers comprising the steps of:

- a) fabricating a reference sample with comprises a sequence of high and low "K" dielectric constant layers;

- b) obtaining spectroscopic data therefrom as said reference sample is fabricated;
- c) fabricating a second sample which is meant to be the same as the reference sample;
- d) obtaining spectroscopic data therefrom as said second sample is fabricated and in real time detecting differences in said spectra as compared to the corresponding references sample spectroscopic data; and
- e) modifying fabrication parameters to minimize said differences.

The second sample of Kiyota's method is in the form of a basic semiconductor wafer that has undergone thin film formation, wet etching, and photolithographic processes resulting in a formation of plural substances such as single crystal silicon and dielectric films on the surface thereof. Then, another thin film of single crystal silicon and dielectric material (germanium) is formed on the surface of this basic semiconductor wafer. The optical constants of the pattern on this second sample are measured using spectroscopic ellipsometry before and after the formation of the second thin film of single crystal silicon and germanium. A differential optical spectrum is found using these two spectroscopic ellipsometry measurements to determine if the thin film growth was satisfactory. (Figures 5 and 7 and column 6, lines 10-26 and 62-64 and column 7, lines 7-10).

If the thin film growth is satisfactory, the thin film is grown under the same conditions. If the thin film growth is different from the desired thin film growth, then the thin film growth conditions are redesigned for proper growth conditions (column 6, lines

26-32). In order for the desired thin film growth to be determined, a reference sample would have to be measured to determine the desired thin film growth. In order for this comparison between a reference and a second sample to be made accurately, the two samples would have to be the same structure, using the same type of film to be grown on the same basic semiconductor substrate and using the same growth process.

Regarding claim 9, the spectroscopic data for each of the two samples is ellipsometric psi and delta. (Figures 5 and 7)

In regards to claim 12, the layers of the sample having a sequence of high and low "K" layers present thereupon includes SiO<sub>2</sub> (column 6, lines 10-12)

Regarding claim 13, the electromagnetic radiation of Kiyota's method is in the form of white light (column 6, lines 62-64).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Solomon et al. (USPN 5,900,633) as applied to claim 3 above, in view of Rosencwaig et al. (USPN 6,278,519).

Solomon does not disclose that a bulk material with minimal native oxide layer is used as one of the samples in the method disclosed above with claim 3. Rosencwaig

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discloses that a common reference sample used in a method for analyzing thin films on semiconductors using spectroscopic ellipsometry is a "native oxide" reference sample. This sample is in the form of a silicon substrate with an oxide layer of a known thickness. (column 1, lines 64-67) It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the native oxide reference sample of Rosencwaig as a reference sample in the method of Solomon since the use of such a sample is common in the art, making the sample readily available.

***Allowable Subject Matter***

Claims 14-18 are allowed.

Claims 10 and 11 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

As to claims 10, 11, and 14, the prior art of record, taken alone or in combination, fails to disclose or render obvious the method of evaluating a thickness during a manufacture of a thin film on a sample comprising finding a difference in the values of

$$N_f = \cos(2\Psi);$$

$$C_f = \sin(2\Psi)\cos(\Delta);$$

$$S_f = \sin(2\Psi)\sin(\Delta);$$

for the ellipsometric spectroscopic values of psi and delta between two samples, in combination with the rest of the limitations of claims 10, 11, and 14.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marissa J. Detschel whose telephone number is 571-272-2716. The examiner can normally be reached on M-F 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr. can be reached on 571-272-2059. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Marissa J Detschel

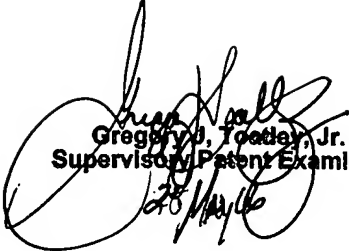
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May 24, 2006

MJD

  
Gregory D. Tooley, Jr.  
Supervisory Patent Examiner